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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the manufacture approach of the light-gage roller especially equipped with thick thin roller rodding, and this light-gage roller about the fixing roller used for electrophotography-type image formation equipment, such as a copying machine, a printer, and facsimile.

[0002]

[Description of the Prior Art] In the roller, the fixing roller used for electrophotography-type image formation equipment, such as a copying machine, carries out the inner package of the heat release equipments, such as a halogen heater, they carry out a pressure welding to an application-of-pressure roller, and it forms the nip section. And such a fixing roller makes the transfer paper sent into the above-mentioned nip section carry out melting fixation of the toner with the pressure of the nip section, and the radiant heat from the above-mentioned heat release equipment.

[0003] From the former, as for the fixing roller, the aluminum alloy is used for the rodding as a raw material for thermally conductive and rigid reservation. The general configuration of such a fixing roller is cylindrical, uses roller rodding of thin meat as a base, to the peripheral face, powder coating of the fluorine coat etc. is carried out, and it calcinates it, and coats a mold release layer.

[0004] Moreover, after the outline of the production process of the above-mentioned fixing roller casts the above-mentioned aluminum alloy material on the roller of a cylinder-like long picture, cuts this to predetermined die length, makes it short length roller rodding, and it carries out surface roughening of the front face by a cut or grinding further in order to stick a mold release layer to the peripheral face, it performs formation of a mold release layer, and predetermined finishing processing, and obtains the fixing roller of a finished product.

[0005] In many cases, surface roughening of roller rodding in the above-mentioned production process is performed by the outer-diameter cut which used the diamond tool. Moreover, this cut is also the process which carries out the thinning of the roller rodding to predetermined thickness simultaneously. On the other hand, in recent years, in order that roller rodding of the above-mentioned fixing roller may raise thermal conductivity, the further thinning is demanded. That is, to shorten time amount (build up time of a fixing roller) until it reaches the temperature which can be established by the thinning of roller rodding, and to advance power-saving of a copying machine etc. is desired.

[0006]

[Problem(s) to be Solved by the Invention] However, as mentioned above, a fixing roller is the being [it / high rigidity] need on the function, and cannot drop thickness of roller rodding in vain. Moreover, with the above-mentioned diamond tool, 0.8mm of the process critical point which can make thickness thin to homogeneity is a limitation now, and, as for the build up time of a fixing roller, about 30 seconds has become a limit with this thickness.

[0007] In addition, the attempt using iron and the raw material of a stainless steel system as an alternative raw material of aluminum alloy material is made, and a manufacturing cost is not balanced

from the problem of the cure against rust proofing, and workability etc., and thermal conductivity is low compared with aluminum alloy material, and the homogeneity of temperature distribution is not fully acquired, either.

[0008] Then, it is to offer the manufacture approach of a fixing roller that the thinning of the roller rodding can be carried out by the simple and cheap approach, and high rigidity can be secured while it offers the fixing roller which has roller rodding which is thin meat and can secure high rigidity from the former, even if the object of this invention uses an aluminum alloy for roller rodding.

[0009]

[Means for Solving the Problem] The fixing roller of this invention which attains the above-mentioned object is characterized by having a convex rib in the inner skin of roller rodding.

[0010] It is desirable to form the above-mentioned rib in the above-mentioned inner skin a swirl or in the shape of a grid. In this case, it is good also as a configuration which the grid rib of the above becomes from at least two or more spiral ribs of the above with which the directions of a volume differ. Furthermore, it is desirable for the lead angle of the spiral rib of the above to be in the range of 2 to 15 degrees.

[0011] The manufacture approach of the fixing roller of this invention of attaining the above-mentioned object is characterized by having the 1st process which forms a slot in the peripheral face of cylinder-like roller rodding, and forms the rib corresponding to the above-mentioned slot in the inner skin of the opposite hand, and the 2nd process which cuts the above-mentioned peripheral face so that the slot formed at this 1st process may be removed.

[0012] It is good though the 1st process of the above is the spinning which is made to carry out both-way migration of the presser-foot member which presses the roller side of roller rodding by which a uniform revolution is carried out to an one direction to the shaft orientations, and forms in the above-mentioned roller side two spiral slots and rib with which the directions of a volume differ.

[0013]

[Embodiment of the Invention] Hereafter, the example of the manufacture approach of the fixing roller of this invention and this fixing roller is explained based on a drawing. First, the configuration of the fixing roller of this example is explained. Drawing 1 is drawing showing the fundamental configuration of the fixing roller set as the application object of this invention. The fundamental configuration of a fixing roller forms the mold release layer 2 for preventing offset of a toner in the cylinder-like roller rodding 1.

[0014] Moreover, as shown in drawing 1, the configuration of the whole fixing roller is the so-called hard drum configuration where the diameter of the ends location of the roller became larger than the diameter of the mid gear of the longitudinal direction. According to this hard drum configuration, the contact pressure of both ends improves among the nip sections formed between the application-of-pressure rollers which are not illustrated. Consequently, the kink of the transfer paper conveyed and generating of Siwa etc. are prevented. In addition, the diameter difference of the ends location and mid gear in the above-mentioned hard drum configuration has about 0.08 commonmm. [0015] The fixing roller of this invention is the configuration which formed the rib in the inner skin of the roller rodding 1 shown in drawing 1, and used the roller side as thin meat conventionally. The example of a configuration of the above-mentioned roller rodding 1 by which the rib 3 was formed in inner skin from drawing 2 at drawing 4 is shown. About arrangement and the configuration of the rib 3 which can be cast to the inner skin of such roller rodding 1, although various patterns can be considered, three kinds of examples of a configuration are shown in each drawing here.

[0016] a part of roller rodding 1 in which drawing 2 formed the rib 3 spirally -- it is a block diagram. In this drawing, the sectional view which cut (a) with drawing of longitudinal section of a fixing roller, and cut (b) by the A-A line of (a), and (c) are the perspective views which expanded a part of cross section of a roller side.

[0017] As shown in drawing 2, one rib 3 is spirally formed in the inner skin of this roller rodding 1 towards the other-end section from one edge of a roller. Moreover, this rib 3 is formed only in the inner skin of the roller rodding 1, and that peripheral face is a uniform peripheral surface like the conventional

fixing roller.

[0018] As shown in the enlarged drawing of drawing 2 (c), roller side 1a in which a rib 3 is not formed among roller sides is very thin meat. In this example, the thickness of this roller side 1a has become 0.3mm order.

[0019] thus, the former -- thin -- at the time of a carrier beam, since the temperature rise per unit time amount is earlier than before, the **** roller side is enabling compaction of the build up time of a fixing roller of the radiant heat from the halogen heater by which an inner package is carried out into the roller rodding 1. Moreover, the rib 3 which did not break off on inner skin and was formed continuously has given sufficient reinforcement which can be equal to a pressure-welding revolution with an application-of-pressure roller.

[0020] The roller rodding 1 of drawing 3 is the example of a configuration in which this and the direction of a volume formed the reverse spiral rib 3 in addition to the spiral rib 3 of the one direction shown by drawing 2. In this case, two spiral ribs 3 are the so-called blue flag grid-like ribs 3, and are raised with still more sufficient balance [reinforcement] from the case of the roller rodding 1 of drawing 1.

[0021] Like drawing 3, although drawing 4 is the example of a configuration in which the grid-like rib 3 was formed, it forms in inner skin the rib 3 of two or more shape of a straight line parallel to shaft orientations, and the rib 3 of the shape of two or more ring which crosses these at a right angle at equal intervals in this case, respectively.

[0022] In the example of a configuration of drawing 4, only the roller rodding 1 is illustrated from drawing 2, and each [these] roller rodding 1 will serve as a fixing roller of drawing 1, if the mold release layer 2 and the elastic layer which consists of a rubber member which is not illustrated are prepared in each peripheral face. As for the mold release layer 2 of the above-mentioned roller rodding 1, the thin film of 10-30 micrometers of thickness is formed of the powder coating of a fluororesin. Moreover, for example, in preparing an elastic layer, elastic layers, such as a rubber member, are prepared on the roller rodding 1, and it becomes the multistory structure in which the above-mentioned mold release layer 2 was formed on the front face of this elastic layer.

[0023] Below, the manufacture approach of the fixing roller of this invention is explained. First, if the general order of a process in the manufacture approach of the conventional fixing roller is explained, it will be carried out in order of the molding process of the tubed roller rodding 1, the surface roughening process of a peripheral face, the formation process of the mold release layer 2, and the polish process (process of finishing) of a roller side.

[0024] In addition to the above-mentioned conventional process, by the manufacture approach of this example, formation of a rib 3 is performed to the roller rodding 1 in front of the process of the above-mentioned surface roughening. In addition, the same raw material as the former and roller rodding of the same size can be used for the roller rodding 1 which serves as an object for processing here.

[0025] The rodding 1 ("rodding" is called hereafter) which cast hereafter the aluminum alloy material which becomes an object for processing from A5052 material periphery diameter $\phi 30.0\text{mm}$, overall-length L380.0mm, and thickness t1.0mm in the shape of a cylinder is used. And the case where the blue flag grid rib 3 of the above as shown in the inner skin of this rodding 1 by drawing 3 is formed is taken for an example, and one example of the manufacture approach is explained.

[0026] In manufacture of the fixing roller of this example, the formation process of the rib 3 to inner skin consists of two processes which used the CNC engine lathe. The 1st process is the spinning to the above-mentioned rodding 1, and the 2nd process is the cut of a peripheral face.

[0027] At the 1st process, an outline of the formation process of the above-mentioned rib 3 performs spinning so that a spiral slot may be formed in the peripheral face of rodding 1, where the chuck of the rodding 1 is carried out pivotable with the main shaft of a CNC engine lathe. In this process, the above-mentioned rib 3 is formed in the inner skin on that background at the formation and coincidence of a slot by spinning. Subsequently, the 2nd process is performed on a CNC engine lathe. The peripheral face of rodding 1 is cut, the above-mentioned slot on the peripheral face is removed, and the roller rodding 1 which left only the above-mentioned rib 3 to that roller side is cast by this 2nd process.

[0028] Drawing 5 is the detail block diagram of the rib formation implement 4. the presser-foot member which the above-mentioned rib formation implement 4 becomes from the spinning roller 5 as shown in drawing 5 -- having -- this spinning roller 5 -- bearing material 4a -- being pivotable (arrow head A) -- the nose for being supported and fabricating slot 3a -- it has 5a. Moreover, the spinning roller 5 is held pivotable at the above-mentioned bearing material 4a every arm 4b, and rotates to a radial direction (arrow head B). in addition -- this example -- the spinning roller 5 -- an outer diameter -- 150.0mm and a nose -- R of the part of 5a is using the thing of the size of 2.0 (mm).

[0029] Drawing 6 and drawing 7 are drawings showing the process of the spinning which forms the blue flag grid-like rib 3. The place in which drawing 7 forms 2 Motome's rib 3 for the place in which drawing 6 forms 1 Motome's rib 3 is shown. Moreover, in each of these drawings, (a) shows signs that developed the spiral in (b), made into the straight line signs that it saw from the side, and they were seen from the upper part.

[0030] Moreover, drawing 8 is the sectional view having expanded and shown signs that slot 3a and a rib 3 were formed in a roller side by the above-mentioned rib formation implement 4. In spinning, migration control of the above-mentioned rib formation implement 4 is carried out through arm 4b at the shaft orientations of rodding 1, and point-to-point control of the spinning roller 5 is carried out to the radial direction. And when this spinning roller 5 is positioned on rodding 1 so that slot 3a of a predetermined dimension may be fabricated to the peripheral face of rodding 1, it will follow with the revolution of this rodding 1, and it will rotate.

[0031] it is shown in drawing 8 -- as -- the spinning roller 5 -- the above-mentioned follower revolution - - configuration 5a (a "nose" is called hereafter) of the periphery edge -- the peripheral face of rodding 1 - - continuous -- pushing in -- a peripheral face -- denting -- spiral slot 3a -- moreover, a rib 3 is simultaneously formed in inner skin.

[0032] Moreover, originally in the 1st process, formation of the blue flag grid rib 3 of the above can consider two kinds of approaches. The 1st approach is an approach to which the rib formation implement 4 is made to go and come back, rotating rodding 1 in the fixed direction like this example, and after the 2nd approach reverses the hand of cut of rodding 1 and returns the rib formation implement 4 to the original location after 1 Motome's formation, it is the approach of sending in the same direction again.

[0033] As shown in drawing 6 and drawing 7 , in this example, the approach of making carry out both-way migration of the rib formation implement 4, wounding, and forming the grid-like rib 3 is adopted. The floor to floor time which the rib formation implement 4 is made to only go once, can form the blue flag grid rib 3 of the above by this approach, and is spent on per [of a work piece] one is short, and since productivity improves, it is advantageous to manufacturing-cost reduction.

[0034] In addition, it is determined by the rotational speed of rodding 1, the passing speed (feed per revolution) of the rib formation implement 4, the include angle of the radial direction of the spinning roller 5, and the amount of pushing it is [amount] nose 5a of the spinning roller 5 of what kind of configuration slot 3a (inner skin rib 3) is formed in the peripheral face of the above-mentioned rodding 1. Here, it is good for the program to which the above-mentioned CNC engine lathe is moved in setting out of such processing conditions to divert what was set to the so-called chasing.

[0035] the main processing conditions of spinning [in / on the 1st process of the above, and / this example] -- a main shaft engine speed -- 60.0rpm -- carrying out -- feed-per-revolution f of the rib formation implement 4 -- 10.0 mm/rev -- carrying out -- a nose -- the amount of pushing of 5a was set to 1.0mm. In this case, if the periphery diameter of rodding 1 is set to D, it can ask for spiral lead angle alpha (include angle with the flat surface at which it crosses at right angles to shaft orientations) from the following formula.

$\tan \alpha = f / \pi D$ [0036] In the spinning of the above-mentioned processing conditions, lead angle alpha of a rib 3 becomes 5 degrees. Thus, in case it can ask for lead angle alpha by count or lead angle alpha is set as arbitration, the processing conditions of an and also [it is the need] can be searched for. In addition, positioning to a radial direction is performed by lead angle alpha called for as mentioned above, and the above-mentioned rib formation implement 4 is ****. Moreover, slot 3a of a peripheral

face and the rib 3 of inner skin became the following sizes by the above-mentioned spinning.

Slot 3a; depth d0.6-0.8, width-of-face h1.0-1.2 (mm)

Rib 3; height d'0.3 to 0.5, width-of-face h'0.6-0.8 (mm)

[0037] After the 1st process of the above is completed, it goes into the 2nd process which removes the slot of the above-mentioned peripheral face succeeding on a CNC engine lathe. As a cut in this 2nd process, the outer-diameter cut by the diamond tool 6 is performed to the above-mentioned rodding 1. such a cut is performed for boiling a front face to some extent and carrying out surface roughening in order to secure adhesion with the mold release layer 2 which is for deleting the peripheral face of rodding 1 and removing slot 3a of the peripheral face, and is formed behind. In addition, it may replace with the cut by the cutting tool, or the grinding process by the grinding stone may be performed.

[0038] Drawing 9 is the sectional view having expanded and shown signs that the peripheral face of rodding 1 was cut. In this example, the processing conditions of a cut were set to main shaft engine-speed 4500rpm, and it was processed as feed-per-revolution 0.13 mm/rev of a diamond tool 6. Here, a depth of d " of shaving by the diamond tool 6 which should be set up serves as a numeric value which changed with depth d of the above-mentioned slot 3a. That is, as shown in drawing 8, it is necessary to set up a depth of d " which loses the irregularity of the peripheral face of rodding 1 and is equalized, and to remove slot 3a thoroughly. Moreover, the above-mentioned cut is also the process which closing-in-izes rodding 1. For example, if depth d of slot 3a is 0.6mm, it is possible to set a depth of d " of shaving of a diamond tool 6 as 0.7, and to make a roller side thin to the thickness of 0.3mm. In addition, as for the peripheral face after the above-mentioned outer-diameter cut, about 3-micrometer field granularity (Rz) is obtained from cutting conditions, such as the feed per revolution.

[0039] Surface roughening by the cut using the above-mentioned diamond tool 6 in the 2nd process of the above was performed also by the production process of roller rodding from the former for the improvement in adhesion with a mold release layer. So, it uses for the 2nd process of the above for failing to delete the irregularity which consists the process of such surface roughening of slot 3a of the above-mentioned peripheral face by the manufacture approach of this invention. That is, since the same facility as usual can be used and all of clearance of slot 3a, thinning, and surface roughening are moreover performed to coincidence as mentioned above, manufacture by low cost is enabled comparatively.

[0040] After the 2nd process of the above is completed, when it changes especially with the conventional manufacture approach after that, there are nothings. If molding of the roller rodding 1 is completed by the above-mentioned cut, he supposes that sandblasting processing is performed next and is trying to obtain the field granularity Rz of high degree of accuracy further by sandblasting processing in this example. This sandblasting processing used alumina material with a mean particle diameter of 50.0 micrometers (the so-called call grain size is #180), and performed the discharge pressure as 2.5 - 4.0 kgf/cm². In this case, the field granularity of the front face of the roller rodding 1 was set to Rz=9.0-12.0micrometer.

[0041] The roller rodding 1 is moved to paint equipment after the above-mentioned sandblasting processing, powder coating of the fluororesin etc. is carried out, a thin film is formed, subsequently to in baking equipment this is moved, it calcinates under a 380-degree C elevated temperature, and the mold release layer 2 is formed. In this example, as for the mold release layer 2 after baking, 20.0-24.0 micrometers and the field granularity Rz of a front face were set to 2.5-3.0 micrometers by the thickness.

[0042] After the above-mentioned baking process, if tape polish of the roller side is carried out, it will become the finished product of a fixing roller. In addition, the final field granularity Rz of the completed fixing roller is good to make it 2.0 micrometers or less. Drawing 10 is drawing in which having developed the fixing roller 1 which is a finished product, and having shown the formation condition of the rib 3 of the inner skin. The balance of the rib 3 of the 2-way nature given to the inner skin by the above-mentioned spinning of the fixing roller completed as mentioned above is good, and it is formed together with regular intervals.

[0043] In addition, as for lead angle alpha of the blue flag grid-like rib 3, it is desirable experientially

that it is in the range of 2-15 degrees, and as described above, lead angle alpha of this example is 5 degrees. Moreover, by changing the conditioning of spinning, the blue flag grid rib 3 of the above can change the number of the spiral, above-mentioned lead angle alpha, etc., and can secure the optimal creep property corresponding to the service condition of the fixing roller, and the amount of deflections. [0044] Although explanation of the above example is about a fixing roller, the development sleeve of this invention of not only a fixing roller but a drum photo conductor and a development counter etc. is cylindrical, and if it is the roller of thin meat, it can be applied like a fixing roller, and is considered that it can acquire the same effectiveness.

[0045]

[Effect of the Invention] As explained above, since the fixing roller of this invention is the configuration of having a convex rib in the inner skin of roller rodding, it can secure the rigidity of a roller, and can attain the thinning of a roller side, and can shorten the build up time of a fixing roller. According to the configuration which formed the above-mentioned rib a swirl or in the shape of a grid especially, high rigidity is securable.

[0046] The 1st process which the manufacture approach of the fixing roller of this invention forms a slot in the peripheral face of cylinder-like roller rodding, and forms the rib corresponding to the above-mentioned slot in the inner skin of the opposite hand, Since it is the approach of having the 2nd process which cuts the above-mentioned peripheral face so that the slot formed at this 1st process may be removed A rib can be formed cheaply and simply using a facility of the existing engine lathe etc., and a process limitation falls by existence of the rib of the above-mentioned inner skin in the 2nd process of the above, and the thinning of the roller side can be carried out conventionally.

[0047] Moreover, in the 1st process of the above, both-way migration of the presser-foot member which presses the roller side of roller rodding by which a uniform revolution is carried out to an one direction is carried out to the shaft orientations, according to the approach of performing spinning which forms in the above-mentioned roller side two spiral slots and rib with which the directions of a volume differ, blue-flag grid the slot and the rib of the above can be formed simply in a short time, and a manufacturing cost can be reduced by compaction of floor to floor time.

[Translation done.]